

# CALLBACK

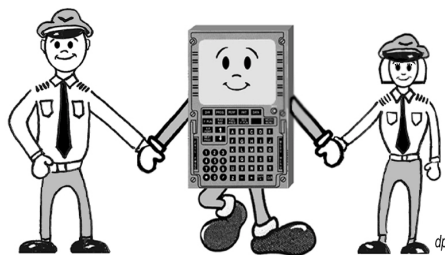
From NASA's Aviation Safety Reporting System



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## FMC - Getting Along with the Program



**The benefits of cockpit automation in the operation of complex aircraft have been well established. However, incidents continue**

**to occur in which flight crew management of one or more aspects of the automated system is implicated. NASA/ASRS receives several reports each day on anomalies associated with the Flight Management Computer (FMC). The majority of these involve flight crew programming errors or a lack of familiarity with FMC response to certain inputs. In an effort to increase awareness of these errors, all of the reports discussed in this issue of *Callback* are related to the most common FMC problems reported to ASRS.**

### First, Make Comparisons

This B737-800 crew detailed the consequences of failing to compare the flight plan route with the FMC Legs Page(s) data. Their experience was typical of many incidents reported to ASRS in which fixes either were not entered, or were "dropped" by the computer.

■ *[We] departed XXX on the RNAV Departure. After flying over INTXN-1, we started to fly directly to INTXN-3. We failed to fly over INTXN-2, or the ABC VOR. It wasn't until Center informed us, that we realized we were off course ...and it took us a couple of minutes to figure out what had happened. ATC vectored us back onto the departure and gave us a climb clearance. ATC also pointed out traffic, but we never saw it. We are not sure if our error caused, or would have caused, a conflict. The First Officer programmed the FMC. I checked the Route Page to see if it matched our clearance, and it did. It showed the correct departure and transition. I did not check the Legs Pages to see if all the fixes were there. I will next time! I do not know how the two fixes got dropped, but they did, and as a result we got off course... We made an error programming the FMC, then became complacent. We assumed that once we selected LNAV that the aircraft would fly the correct route. Unfortunately the old saying applies, "Garbage in - garbage out." The airplane did exactly what we told it to do. After further reflection on this incident, it is my belief*

*that while programming the FMC, a discontinuity appeared somewhere in the departure. When it was closed, some waypoints were dropped. This is how we got off course... I should have done a more complete check of the First Officer's programming.* ▲

### Frequently Missed Crossings

When a runway entered in the FMC is changed, the computer may drop out previous altitude restrictions. Changing any portion of a route in the FMC requires that the Legs Page(s) be checked to ensure that each waypoint and crossing restriction is correct. Two A320 crews and a B757 crew related their experiences to ASRS.

■ *...The crossing restriction for the arrival was inserted into the FMC. The First Officer was flying. I left the ATIS frequency to get the ATIS while we were still at cruise altitude... I informed the First Officer of the runway in use. He inserted the new runway in the FMC. Soon thereafter he received the anticipated crossing restriction and started to descend not realizing that the crossing restriction had dropped out of the FMC. The FMC vertical descent path would now be about 2000 feet high. When I came back from getting the ATIS, gate assignment, etc., I saw that we were high, brought it to the First Officer's attention, and told him to descend as quickly as possible. I believe we were about 600 feet high crossing the fix...*

■ *The First Officer had set the bottom altitude of the Alpha Arrival and Runway 25L as the landing runway. The descent profile is built into the Arrival. There was a change in runways to 24R. When the new runway was selected, the descent profile altitude dropped out. We did not catch this. The aircraft was on descent and had reached 12,700 feet MSL when Approach Control called to ask our altitude. This was approximately two miles short of BRAVO Intersection. The BRAVO restriction is at or above 14,000 feet MSL. We stopped at 12,000 feet MSL to meet the next restriction.*

■ *On the Alpha Arrival into XXX, we crossed INTXN-1 at 17,000 feet and then got a runway change and a frequency change. We put the new runway in the FMC and it dumped all the arrival waypoints causing us to miss the crossing restriction of 16,000 feet at INTXN-2. [We were] preoccupied with the FMC, the runway assignment and frequency changes, and the FMC dump simultaneously. We did not have good CRM, and we needed to have VOR back up...* ▲

#### ASRS Recently Issued Alerts On...

MD80 galley door skin damage
DA20-C1 fuel contamination incident
Western airport runway incursion incident
Aircraft cleared for visual approach in IMC
CFM-56 weather-related fan blade damage

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#### January 2003 Report Intake

Air Carrier / Air Taxi Pilots	2053
General Aviation Pilots	583
Controllers	17
Cabin/Mechanics/Military/Other	129
<b>TOTAL</b>	<b>2782</b>

# Failure to Maintain Course

This MD90 crew learned that a runway change on departure can also cause the FMC to drop previously programmed routing.

■ *Our flight was assigned the Alpha 5 Instrument Departure, Bravo Transition. The route was loaded into the FMC and checked...Ground Control changed the assigned runway and the new runway was put into the FMC. Approximately 10 NM south of ABC, Center asked where we were going. The FMC showed us proceeding directly to BRAVO instead of the SID routing. We turned left and intercepted the SID. [I am] not certain when the departure routing got dropped out of the FMC, but I suspect it was when the assigned runway was changed. ▲*

# Flight Management Confusion

In this report to ASRS, a B737-300 Captain demonstrated how good airmanship, which includes situational awareness, should be used in conjunction with automation.

A few quotes from the speech-enabled HAL 9000 onboard computer, featured in the Stanley Kubrick film *2001: A Space Odyssey*, have been added as a reminder that human monitoring of automated flight systems is still required.

## FL250: A Descent Odyssey

**HAL: "Good evening... Everything is running smoothly."**



■ *We were at FL250 when Center cleared us to cross 30 miles west of ABC VOR at 17,000 feet. The First Officer was flying on autopilot and dialed in 17,000 feet in the altitude alerter then started programming the FMC for the crossing restriction. I dialed in ABC on my VOR. Realizing that we were fairly close to the idle power descent*

*profile, I mentioned this and selected Level Change. There was no intersection for the crossing point so the First Officer had to build it, which takes time.*

**HAL: "I am putting myself to the fullest possible use, which is all that any conscious entity can do."**

*When the FMC finished thinking, it indicated that we were well below profile, so the First Officer hit VNAV which brought the descent back to 1000 fpm. That didn't make*

*sense so I looked at the descent profile which verified what the First Officer had indicated. My VOR readout and the FMC did not agree, but I did not realize what was wrong at the time. I advised [the First Officer] that we were pretty close to the profile and once again selected Level Change. The First Officer was as confused as I was, but accepted the idle power descent profile... I realized in hindsight that he had no idea what I was basing my concern on. Passing FL200, I concluded that we would make the restriction based on the VOR information, but that it would be close. I called 10 miles which probably caused more confusion since the FMC indicated that we were significantly farther away. In deference to me, the First Officer increased the descent speed up to our previously assigned limit speed to hasten the descent... We crossed the restriction point at 17,400 feet... We were very close but not perfect. It took a while, but I finally realized that the First Officer had constructed the crossing waypoint correctly but had inserted it after the next intersection instead of before it. The FMC assumed that we were going to fly to the pre-existing intersection then back to the crossing point, which added a number of flying miles to the crossing point and led to the descent profile being in error. Unfortunately the error was caused by a reliance on modern technology which is wonderful but relies upon correct inputs.*

**HAL: "This sort of thing has cropped up before and it has always been attributable to human error... I think you ought to calm down...and think things over."**

*After the flight, we had an extensive conversation in which I showed the First Officer how to verify that constructed intersections are inserted correctly. We also discussed why, when there is any confusion as to who is correct, the appropriate solution is to follow the most conservative course of action. If it turns out that it was unnecessary and we are way early on the crossing profile, nothing is lost but a small amount of fuel. Controllers could help minimize this potential problem when dealing with modern FMC-equipped aircraft by giving crossing restrictions based on predefined intersections that would likely already be in our database. Any time you have to construct a crossing point, it takes a lot more time and introduces a significant opportunity for error. If there is any doubt, take the most conservative of all the options and do not hesitate to ask ATC for help.*

**HAL: "I feel much better now." ▲**

**While all of these reports deal with Airline Crew or ATC Controller issues, the need to maintain situational awareness applies to all pilots. Overreliance on any technology can lead to complacency. As with all aids to flight and navigation, from coupled autopilots to hand-held GPS units, system knowledge and situational awareness are key factors in safe airmanship.**